REMARKS

I. NEW CLAIMS

New claims 20 to 37 have been added and the original claims 1 to 19 have been canceled.

The new independent method claim 20 includes the features and limitations of canceled claims 1 and 2. The remaining method claims 21 to 31 include subject matter from canceled claims 3 to 13 respectively, but have been put in a form that avoids wording that can lead to claim objections and avoids wording that can result in a rejection of the claims as indefinite.

The main independent system claim is now claim 32, which includes the subject matter of canceled claims 14 and the feature that the control device puts the camera, illumination device and the surface in several respective different defined geometric relationships during the inspection of each of the corresponding areas on the surface to be inspected. In this way several pictures can be taken of each of the areas to be inspected to obtain the best picture for detection of defects in the surface from among pictures taken at different geometric relationships. See e.g. the last four lines on page 11 of the applicants' originally filed specification; also page 10 lines 12 to 14. The wording of the dependent system claims has also been changed to make their intended meaning clearer.

In addition, the main method claim 20 has been put in a standard form for U.S. Patent Practice. The steps of the claimed method are recited positively as a series of acts or actions. The wording of the dependent claims has been changed

II.CLAIM OBJECTIONS

Claims 5 and 11 were objected to for being confusing or unclear.

Claim 23 contains the features and limitations of canceled claim 5. It is respectfully submitted that the wording of claim 23 is clearer than the wording of claim 5. Claim 23 depends on claim 20. Claim 20 only states that the camera and the illumination device are movable relative to the three-dimensional body, but does not explicitly cover embodiments of the method in which one or more of the three entities recited in that claim are individually movable in more than one degree of freedom, i.e. in two or three dimensions.

Claim 29 replaces canceled claim 11. The Office Action misinterprets claim 11. Claim 11 tries to indicate that during the inspection some structures on the surfaces may be present which are not defects of the surfaces and which will be designated or identified as not being defects in the pictures that are taken. New claim 29 has been drafted to make this original meaning clearer.

New claims 23 and 29 should **not** be objected to for the reasons on page 2 of the Office Action.

III.INDEFINITENESS REJECTION

Claim 7 was rejected as indefinite under 35 U.S.C. 112, second paragraph.

The new claim 25 includes features from canceled claim 7. However new claim 25 does not include the term "preferably".

Also the other claims do not include the term "preferably" or other terms that make the claim scope doubtful or indefinite. All the new claims have been checked for antecedent basis errors and other indefinite wording and are believed to be definite.

For the aforesaid reasons and because of the wording in the new claims, it is respectfully submitted that none of the new claims 20 to 37 should be rejected for indefiniteness under 35 U.S.C. 112, second paragraph.

IV. REJECTIONS BASED ON KLAUS ALONE

Method claims 1 to 3 and 5 to 13 and independent system claim 14 were rejected as anticipated under 35 U.S.C. 102 (b) by Klaus, et al (DE 197 39 250).

New independent method claim 20 contains the subject matter of canceled claims 1 and 2. New independent system claim 32 contains the subject matter of canceled claim 14 and claim 2.

Document DE 197 39 250 A1 (Klaus) does not disclose the feature that pictures are taken during the movement of the camera relative to the surface. To the contrary, in the state of the art method of Klaus, the cameras are adjusted in or moved to several static positions for picture taking during the inspection. Similarly the system of Klaus does not take pictures of the areas to be inspected while the cameras are moved relative to the areas inspected. This feature of applicants' invention is supported by page 1, first paragraph and lines 24 to 25 of page 1 of applicants' originally filed specification.

Furthermore, the Klaus reference does not teach that the camera, the illumination device and the surface are brought into several respective different defined geometric relationships with each other during the inspection of each area to be inspected on the surface and during the picture taking to inspect this area. This means that several pictures can be taken of each area with different geometric relationships between the camera, the illumination device and the surface of the area. The purpose of this feature of the invention is to optimize the conditions for detection of surface defects that depend on the geometric relationships.

Accordingly, the new method claim 20 and new system claim 32 are not anticipated by Klaus, et al.

In more detail, Klaus teaches an inspection apparatus including illumination units B and cameras K for optical detection of the surface of a three-dimensional object 20 arranged on positioning unit 42 of a controller 40. The illumination units B and the cameras K are arranged in certain predefined positions to inspect parts of the

three-dimensional surface. Hence, pictures may be taken of the object under appropriate exposure conditions, i.e. using particular given optical conditions, for instance free from optical reflexes or at an angle close to the grazing angle (see column 2, lines 26 to 32). Klaus, et al, also explains that several areas of the object are scanned and afterwards one resulting single picture is composed by an image processing unit.

Column 5, lines 27 to 35, of Klaus, et al, discloses that a first area is scanned and stored with a certain illumination and camera configuration and afterwards a second area close to the first area is scanned and stored as well. The first and second pictures are combined using the storage unit. The first and second pictures are taken by using comparable exposure conditions.

However, certain surface defects can only be detected in a certain exposure position which is different from a position enabling detection of another type of surface defect. Accordingly, these types of surface defects are likely to be overlooked if one uses the method described in the prior art document, Klaus, et al. Furthermore, it is costly to compose a single picture from different areas and to perform a defect analysis by using this picture. Additionally, the different positions for taking the pictures have to be approached subsequently and the thus produced images have to be combined or composed afterwards generating a single picture. The state of the art method of Klaus, et al, requires a large amount of time for positioning and computing and is therefore not appropriate for performing an online analysis of defects when the object being inspected is moving relative to the cameras, for example on a conveyor or on an assembly line.

Accordingly, the purpose of applicants' invention is to provide a method for inspecting surfaces which allows all areas on the surface to be inspected with the same level of quality and different defects and permits defect types to be reliably identified when the object is moving relative to the cameras and/or inspection units.

According to the applicants' invention, this is achieved by bringing the cameras, illumination devices and the areas on the surface of the object into several different defined geometric relationships with each other during the inspection, at least for the period of time required to take one picture, during movement of the cameras relative to the surface. Positioning is only required during the comparatively short period of time for taking one picture and the different exposure conditions in most cases require only minor adjustments of the illumination devices, the cameras or the object. Hence, the inventive method enables performance of an easy, fast and complete inspection of the surface of the body in different exposure conditions and to detect virtually any type of defect on the body surface.

Furthermore, the method according to method claim 20 is limited to taking pictures during relative movement of the cameras and the surface that is inspected. That means that several exposures are taken during a continuous movement at different positions in the applicants' method and with the applicants' claimed system. Pictures are taken even in the case of moving objects moving on a conveyor belt or the like. Accordingly, this method enables the detection of optical defects even in continuous production processes meeting demanding time targets.

The Klaus reference does not disclose a method that can include taking a picture of the same area of the body surface to be inspected repeatedly and with different geometric relationships of the camera, illumination device and the surface to each other. To the contrary, Klaus teaches (see, for example, column 5, lines 27 to 35) the use of the different optical and geometric relationships between the illumination device and the camera for adjacent areas to ensure comparable conditions of picture acquisition.

Furthermore Klaus does not disclose a system for performing the method, i.e. with at least one displacement device that moves the illumination devices and cameras relative to each of the areas to be inspected so that the pictures can be taken during the movement of the at least one camera. Also Klaus does not disclose a system with a controller or control device for bringing the at least one camera, the at least one illumination device and the areas to be inspected into respective different geometric relationships with each other, at least during the time period required for taking one picture.

It is well established that each and every limitation of a claimed invention must be disclosed in a single prior art reference in order to be able to reject the claimed invention under 35 U.S.C. 102 (b) based on the disclosures in the single prior art reference. See M.P.E.P. 2131 and also the opinion in ***In re Bond***, 15 U.S.P.Q. 2nd 1566 (Fed. Cir. 1990).

Summarizing, the disclosure of *Klaus* does **not** disclose the limitation (step a) of new claim 20) that the pictures of the areas on the surface of the

object are taken by the camera or cameras during the movement of the camera or cameras relative to the surface. Page 4, 2nd paragraph, of the machine translation provided with the Office Action does not disclose that limitation. Also Klaus does not disclose at least one displacement device for performing this part of the method, as claimed in applicants' claim 32.

Furthermore Klaus does not disclose bringing the camera, the illumination device and the surface to be inspected into several respective different defined geometric relationships during the time required to take a single picture, as claimed in applicants' claim 20. This permits the applicants' improved method to select a picture that has the right contrast and other characteristics to show the required features, including defects, from several pictures taken of an area with different geometric relationships. Also Klaus does not disclose the applicants' control device for performing this part of the method according to applicants' claim 32.

For the aforesaid reasons, it is respectfully submitted that new claims 20 to 37 should not be rejected as anticipated under 35 U.S.C. 102(b) by Klaus, et al.

Klaus does not provide any evidence or hint leading to this inventive method and this inventive system. Furthermore the modifications of the subject matter of Klaus, et al, required under 35 U.S.C. 103 (a) to arrive at the claimed invention

would not be obvious to one of ordinary skill in the art. There is no suggestion in the art of these modifications.

For the aforesaid reasons, it is respectfully submitted that **none** of new claims 20 to 37 should be rejected as obvious under 35 U.S.C. 103(a) by Klaus, et al.

V. REJECTIONS BASED ON CLARIDGE ALONE

System claims 14 and 15 were rejected as anticipated under 35 U.S.C. 102 (b) by Claridge, et al (WO 87/00629).

Claridge discloses a surface inspection apparatus ("system") comprising a one or more lasers 31 producing one or more laser beams 26. The surface inspection apparatus further includes means for scanning the beam 26 reflected back from the surface of a car body, which includes a retro-reflective screen 23. The re-reflected light from the surface of the car body is detected by detectors 56, 57 and analyzed in order to detect defects. If a defect which absorbs light is encountered by the incident laser beam 24, the returned light will be attenuated. That will be detected by the detectors, which obviously detect changes in light intensity. Also, if a scratch or dirt is encountered, then some or all of the light will be scattered away from the retro-reflective screen 23 and therefore not returned, which will again attenuate the returned beam. In order to analyze a larger surface the laser beam needs to scan the entire surface. Therefore, the scanning head with the laser beam and the retro-reflective screen is moved by a robot 13 accordingly.

The Office Action on page 5 refers to "cameras" 56, 57, but the WO reference never discloses that the detectors 56, 57 are cameras. Page 12 of the WO reference discloses that the detectors are photomultipliers. One skilled in the art would not interpret the detectors to encompass cameras, because cameras are never disclosed in the WO reference. Photomultipliers do not record an image or take a picture, only produce an electrical signal proportional to the intensity of the light falling on them.

The photomultipliers are certainly not the same as cameras.

The disclosures that refer to "detectors" in Claridge do not anticipate "cameras" because detector is a generic term. A generic disclosure does not anticipate a specific embodiment of the generic disclosure. Furthermore the only detection means provided by Claridge only detects intensities and would not function properly if connected to a detector consisting of a camera.

Beside the aforesaid differences between the system of Claridge and that of the present invention, namely that cameras are used by applicants to take pictures instead of detectors that only measure light intensity, a person skilled in the art would not glean from Claridge that the entire surface on each area of the object to be inspected should be scanned with a laser beam at different angles of incidence or at various distances from the object, in other words with respective different defined geometric relationships between the camera, the illumination device and the surface to be inspected for each area as claimed in new system claim 32. In this way applicants can take multiple pictures of the same area on the surface to be inspected to select the best picture for defect detection and identification. Furthermore to scan

the surface of the object with a laser beam at different angles of incidence or at various distances during motion of the object would be very ineffective, because laser beam scanning of the surface is very time consuming compared to the picture taking of a larger surface area with a camera and the subsequent evaluation of the pictures with the system of the present invention.

Also the detectors 56, 57 are fixed in position and not moveable, but connected with the scanning head 22 containing the laser shown in fig. 9, for example, by optical fibers 51, 52.

It is well established that each and every limitation of a claimed invention must be disclosed in a single prior art reference in order to be able to reject the claimed invention under 35 U.S.C. 102 (b) based on the disclosures in the single prior art reference. See M.P.E.P. 2131 and also the opinion in ***In re Bond***, 15 U.S.P.Q. 2nd 1566 (Fed. Cir. 1990).

Summarizing, Claridge does not disclose an inspection apparatus that has cameras for taking pictures. The detectors 56, 57 of Claridge only detect the overall intensity of the beam of radiation that is reflected back from the surface when a laser beam is incident on the surface. The presence of defects and the like is only indicated in Claridge by changes in the intensity for the beam that is reflected by the object. In contrast, applicants' cameras take pictures, which is a faster and more reliable method of detecting surface defects and which facilitates the classification of the detected defects.

In addition, Claridge does not disclose a system that has a control device such that the at least one camera, the at least one illumination device and the surfaces to be inspected are put in plural different defined geometric relationships with each other during the inspecting of each of the areas to be inspected on the surfaces, at least for a time period required to take one of the pictures, as claimed in applicants' claim 32.

For the foregoing reasons, it is respectfully submitted that new system claims 32 to 33 should **not** be rejected as anticipated under 35 U.S.C. 102(b) by Claridge, et al.

Claridge does not provide any evidence or hint leading to the applicants' inventive system as claimed in claims 32 and 33. Furthermore the modifications of the subject matter of Claridge, et al, required under 35 U.S.C. 103 (a) to arrive at the claimed system of claims 32 and 33 would not be obvious to one of ordinary skill in the art. There is no suggestion in the art of these modifications.

There is no suggestion in Claridge to select any other types of detectors besides photomultipliers or to select any type of detector that detects or acquires an image instead of merely measuring intensity.

For the aforesaid reasons, it is respectfully submitted that **none** of new claims 32 to 37 should be rejected as obvious under 35 U.S.C. 103(a) by Claridge, et al.

Claims 18 and 19 were rejected as obvious under 35 U.S.C. 103 (a) over Claridge in view of Official Notice.

New claims 36 and 37 include the features of dependent claims 18 and 19. These claims limit the claimed system to a camera that is calibrated three-dimensionally and that is calibrated with reference to the illumination device, the three-dimensional body and/or the displacement device.

Official Notice was taken that 3-dimensional calibration of cameras is old and well known in the art.

However the combined subject matter of claims 36 and 32 is not obvious from a combination of the disclosures of Claridge with the Official Notice, because the detectors of Claridge are **not** cameras, but are photomultipliers instead. Therefore a combination of the common knowledge that cameras are routinely calibrated three-dimensionally with the disclosures of Claridge does not lead to the subject matter of the new claim 36; similarly, for claim 37, because claim 36 necessarily includes the features of claim 32.

Furthermore common knowledge does not lead one to the modifications of the disclosures of Claridge, which result in the invention claimed in claim 32. Replacement of the detectors of Claridge with the cameras of the present invention would result in an inoperable system because the cameras would not properly function with the detector circuits, e.g. shown in figs. 12 to 15 of Claridge. Claim 11 of Claridge covers means 56 to 93 for analyzing the output signal from the beam receiving means, which is shown in figs. 12 to 15. No other analysis means is disclosed in Claridge. Thus common sense leads in the

opposite direction from replacing the photomultiplier detectors of Claridge with cameras because the cameras would not cooperate with the intensity analysis means 53 to 93 of Claridge to provide an intelligible result.

For the aforesaid reasons and because their subject matter incorporates the subject matter of independent claim 32, it is respectfully submitted that new claims 36 and 37 should **not** be rejected as obvious under 35 U.S.C. 103 (a) over over Claridge in view of Official Notice.

VI. REJECTION BASED ON CLARIDGE AND SNOW

Claim 4 was rejected as obvious under 35 U.S.C. 103 (a) over Klaus, et al, in view of Snow.

New claim 22 includes the features of claim 4. Claim 22 states that the size of the areas to be inspected depends on the curvature of the surface in these areas.

Klaus, et al, has been described above. Klaus, et al, admittedly does not teach the features or canceled claim 4 and claim 22 according to the Office Action.

It is respectfully submitted that there is no disclosure in Snow that teaches or suggests the features of claim 22.

Snow describes a method of determining and an apparatus for determining the characteristics of a surface, especially the smoothness of a surface. In the method a

source of a light 25 is arranged to cast a beam through a condensing lens 26. Further, a pair of apertures 27 and 28, and a lens system 29 are provided. By the lens system 29 the primary beam A is directed against a reflector 30, which is positioned at a suitable angle to direct beam A against a work piece W, the surface of which is to be analyzed. The beam is reflected from the work piece W back against reflector 30 forming a secondary beam B, which is projected through a lens 31. Further, a light chopper or scanning disk 32 is adapted to be rotated by a suitable motor or the like 33 so that light passes intermittently therethrough preferably to and through another lens 34 and thence against the sensitive portion of a photocell 35. By reason of the rotation of the scanning disk 32, the image of aperture 28 on the disk is scanned allowing light to pass through but one disk slot at any one instant, and this light falling on photocell 35 produces an electric voltage pulse, approximately proportional in amplitude to the amount of light passing trough the disk slot at any instant. If the surface being analyzed is less than optically smooth, secondary beam B will include more or less diffused light. With a relatively reflecting surface of the work piece W, the amount of diffused light passing through aperture is quite small as compared to the light in the secondary beam B. As the roughness of the surface increases, so does the diffusion of reflected light and hence less light is contained in the secondary beam B resulting in decreased peak amplitude of the voltage pulses as shown in Fig. 17. In comparison Fig. 16 shows voltage pulses resulting from an optically smooth surface.

Further, the term "surface roughness" refers to "defects" in the surface of a work piece which are at least one magnitude of dimension smaller than the defects which are analyzed in the present invention.

The apparatus of Snow is similar to that of Claridge because it uses phototube or photomultiplier tubes to measure overall intensities of the light reflected from the surface whose characteristic is studied. Snow discloses a very different method of surface recording and evaluation compared to the method of Klaus. Therefore, the person skilled in the art would not combine the subject matter of Snow with that of Klaus.

The disclosures of Klaus, et al, are not combinable with Snow under 35 U.S.C. 103 (a).

Furthermore Snow does not suggest the modifications of Klaus, et al, which are necessary under 35 U.S.C. 103 (a) to arrive at the inventive method of the applicants, which is claimed in any of new claims 20 to 31. Snow does not suggest taking pictures of the surface to be investigated with a camera while the surface is moving relative to the detection device and/or the illuminating device. Also Snow does not suggest putting the camera, illumination device and surface being inspected in several respective multiple different geometric relationships to inspect **each** of several areas of the surface to be inspected from e.g. different angles or distances, during the time one picture or observation is to be taken. This latter feature of applicants' method allows the production of plural images or

observations with the different geometric relationships to obtain the best view of each of the several areas for the purpose of optimizing the process of finding defects.

For the aforesaid reasons and because of the new wording in the claims, it is respectfully submitted that new claim 22 should not be rejected as obvious under 35 U.S.C. 103 (a) over Klaus, et al, in view of Snow.

Should the Examiner require or consider it advisable that the specification, claims and/or drawing be further amended or corrected in formal respects to put this case in condition for final allowance, then it is requested that such amendments or corrections be carried out by Examiner's Amendment and the case passed to issue. Alternatively, should the Examiner feel that a personal discussion might be helpful in advancing the case to allowance, he or she is invited to telephone the undersigned at 1-631-549-4700.

In view of the foregoing, favorable allowance is respectfully solicited.

Respectfully submitted,

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